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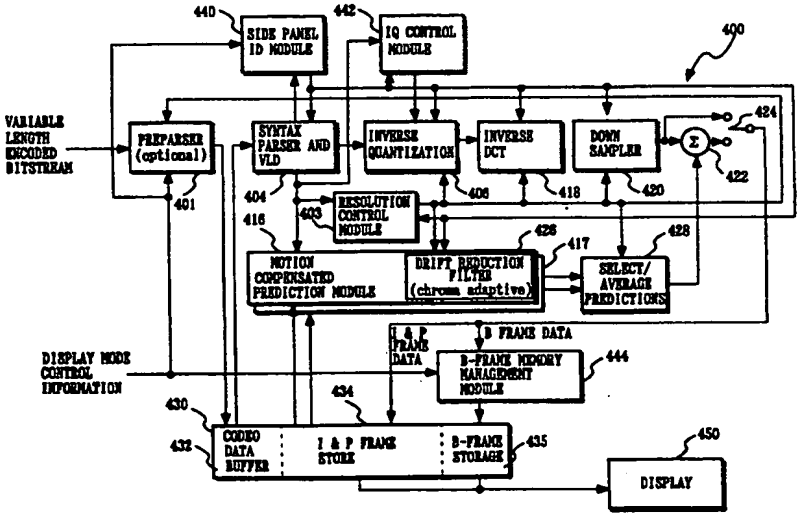
(71) Applicant: HITACHI, LTD. [JP/JP]; 6, Kanda Surugadai 4–chome, Chiyoda–ku, Tokyo 101–8010 (JP).

(72) Inventors: PEARLSTEIN, Larry; 301 Wexley Drive, Newtown, PA 18940 (US). SAZZAD, Sharif, Mohammad; 1013 Southridge Woods Boulevard Street, Monmouth Junction, NJ 08852 (US).

(74) Agent: TOMITA, Kazuko; 7F Yokohama HS–Building, 9–10, Kitasaiwai 2–chome, Nishi–ku, Yokohama–shi, Kanagawa 220–0004 (JP).

(54) Title: METHOD AND APPARATUS FOR VIDEO DECODING AT REDUCED COST



(57) Abstract

Methods and apparatus for implementing video decoders at a reduced cost are described. The methods include data reduction techniques, simplified inverse quantization techniques, and dynamically varying the complexity of image enhancement operations, e.g., prediction filtering operations, as a function of whether luminance or chrominance data is being processed. In order to reduce data storage requirements, luminance and chrominance data corresponding to previously encoded images may be stored at different resolutions, portions of B frames which will not be displayed are discarded. Portions of I and P frames which will not be displayed, decoded at reduced resolution and/or using simplified inverse quantization techniques. Another data reduction technique involves applying different amounts of data reduction, e.g., downsampling, to different image portions with no or little downsampling being performed on image portions located near the image's center of interest as determined from information included in a received encoded bitstream.

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Claims

1. A method of processing encoded data, the encoded data including encoded B frame data, the method comprising the steps of:

receiving the encoded B frame data;

identifying a portion of the B frame corresponding to an image side panel which will not be displayed;

performing a decoding operation on the received encoded B-frame data to produce decoded B-frame data;

storing decoded B-frame data in a memory device without storing B-frame data corresponding to the identified B-frame image side panel.

2. The method of claim 1, further comprising the step of:

generating an image on a display device from the stored decoded B-frame data.

3. The method of claim 1, further comprising the step of:

discarding B-frame data representing the identified B-frame image side panel prior to performing the step of storing decoded B-frame data.

4. The method of claim 3, wherein the step of:

discarding B-frame data is performed prior to performing the decoding operation.

5. The method of claim 3, wherein the step of:

discarding B-frame data is performed as part of the decoding operation.

6. The method of claim 3, wherein the step of identifying a portion of the B frame corresponding to an image side panel which will not be displayed includes the step of:

examining center of interest information included in the encoded B frame data.

7. The method of claim 1, wherein the encoded data further includes encoded I frame data, the method further comprising the steps of:

identifying a portion of the I frame corresponding to an image side panel which will not be displayed;

decoding the encoded I-frame data, the method of decoding the I frame including the step of:

decoding the encoded I frame data representing the I frame image side panel at a lower resolution than the resolution at which the data representing another portion of the I frame is decoded.

8. The method of claim 7, wherein the step decoding the encoded I frame data representing the image side panel further includes the step of:

performing a downsampling operation.

9. The method of claim 7, further comprising the step of:

storing the decoded I frame data in a memory device; and

using at least some of the decoded I frame data to perform a motion compensated prediction operation.

10. The method of claim 1, wherein the encoded data further includes encoded data representing a P frame, the method further comprising the steps of:

identifying a portion of the P frame corresponding to an image side panel which will not be displayed;

decoding the encoded P frame data, the method of decoding the P frame including the step of:

decoding the encoded data representing the P frame image side panel at a lower resolution than the resolution at which the data representing another portion of the I frame is decoded.

11. The method of claim 10, further comprising the step of:

storing the decoded P frame data in a memory device; and

using at least some of the decoded P frame data to perform a motion compensated prediction operation.

12. A method of processing and displaying video data, including data representing a bi-directionally coded image and an intra-coded image, the method comprising the steps of:

storing data representing the intra-coded image;

discarding data corresponding to a portion of the bi-directionally coded image which will not be displayed;

storing data representing a portion of the bi-directionally coded image which will be displayed;

displaying a first image generated from the data representing the stored intra-coded image; and

displaying a second image generated from the stored data representing a portion of the bi-directionally coded image.

13. The method of claim 12, further comprising the step of:

using the stored intra-coded image data as reference data when performing a motion compensated prediction operation.

14. The method of claim 13, further comprising the step of:

receiving data representing the intra-coded image,

identifying portions of the intra-coded image which will not be displayed; and

applying a downsampling operation on the data representing the identified portions of the intra-coded image prior to performing the step of storing data representing the intra-coded image.

15. A method of processing encoded video data, comprising the steps of:

receiving encoded data representing at least one intra-coded image only a portion of which is to be displayed after decoding;

decoding the encoded data representing the portion of the intra-coded image which is to be displayed after decoding at a first resolution; and

decoding the encoded data representing the portion of the intra-coded image which is not to be displayed after decoding at a second resolution which is lower than the first resolution.

16. The method of claim 15, wherein the portion of the intra-coded image which is not to be displayed is an image side panel.

17. The method of claim 15, further comprising the step of:

storing the decoded data representing the portion of the intra-coded image which is to be displayed and the portion of the intra-coded image which is not to be displayed in a memory device.

18. The method of claim 17, further comprising the steps of:

receiving encoded data representing at least one bi-directionally coded image only a portion of which is to be displayed after decoding;

discarding encoded data representing a portion of the bi-directionally encoded image which will not be displayed;

decoding the encoded data representing the portion of the bi-directionally encoded image which is to be displayed after decoding; and

storing the decoded image data.

19. A method of decoding encoded image data, comprising the steps of:

identifying a center of interest of an encoded image by examining the encoded image data for center of interest information included therein;

decoding a first portion of the encoded image data representing a first image portion located a first distance from the identified center of interest in accordance with a first decoding procedure; and

decoding a second portion of the encoded image data representing a second portion of the encoded image located a second distance from the center of interest using a second decoding procedure which is less resource intensive than the first decoding procedure, the second distance being greater than the first distance.

20. The method of claim 19, wherein the first decoding procedure includes the step of:

performing an MPEG-2 compliant inverse quantization operation; and

wherein the second decoding procedure includes the step of:

performing a non-MPEG-2 compliant inverse quantization operation.

21. The method of claim 20, wherein the second decoding procedure further includes the step of:

performing a data reduction operation.

22. A method of processing encoded video data, comprising the steps of:

receiving encoded data representing at least one predictively-coded image only a portion of which is to be displayed after decoding;

decoding the encoded data representing the portion of the predictively-coded image which is to be displayed after decoding at a first resolution; and

decoding the encoded data representing the portion of the predictively-coded image which is not to be displayed after decoding at a second resolution which is lower than the first resolution.

23. The method of claim 22, wherein the portion of the predictively-coded image which is not to be displayed is an image side panel.

24. The method of claim 22, further comprising the step of:

storing the decoded data representing the portion of the predictively-coded image which is to be displayed and the portion of the predictively-coded image which is not to be displayed in a memory device.

25. A video decoder apparatus, comprising:

means for identifying and discarding encoded image data representing a portion of a B-frame which is not to be displayed;

means for decoding encoded image data representing a portion of a bi-directionally coded frame which is to be displayed; and

a memory device coupled to the means for decoding for storing decoded image data.

26. The video decoder apparatus of claim 25, further comprising:

a circuit for identifying image data representing a portion of an I-frame which is not to be displayed; and

a data reduction device for performing a data reduction operation on the data representing the portion of the I-frame which is not to be displayed.

27. A video decoder apparatus, comprising:

a circuit for identifying image data representing a portion of an intra-coded frame which is not to be displayed;

a data reduction device for performing a data reduction operation on the data representing the portion of the intra-coded frame which is not to be displayed;

a storage device for storing the data generated by the data reduction device; and

a motion compensated prediction circuit coupled to the storage device for using the stored data to perform a motion compensated prediction operation.

28. The video decoder apparatus of claim 27, further comprising:

means for decoding at full resolution intra-coded data which is to be displayed; and

a display device for displaying decoded intra-coded data.

29. A video decoder apparatus, comprising:

a circuit for identifying image data representing a portion of a predictively-coded frame which is not to be displayed;

a data reduction device for performing a data reduction operation on the data representing the portion of the predictively coded frame which is not to be displayed;

a storage device for storing data generated by performing the data reduction operation; and

a motion compensated prediction circuit coupled to the storage device for using stored data to perform a motion compensated perdition operation.

30. The video decoder apparatus of claim 29, further comprising:

means for decoding at full resolution predictively-coded data which is to be displayed; and

a display device for displaying decoded predictively-coded data.

FIG. 1 PRIOR ART

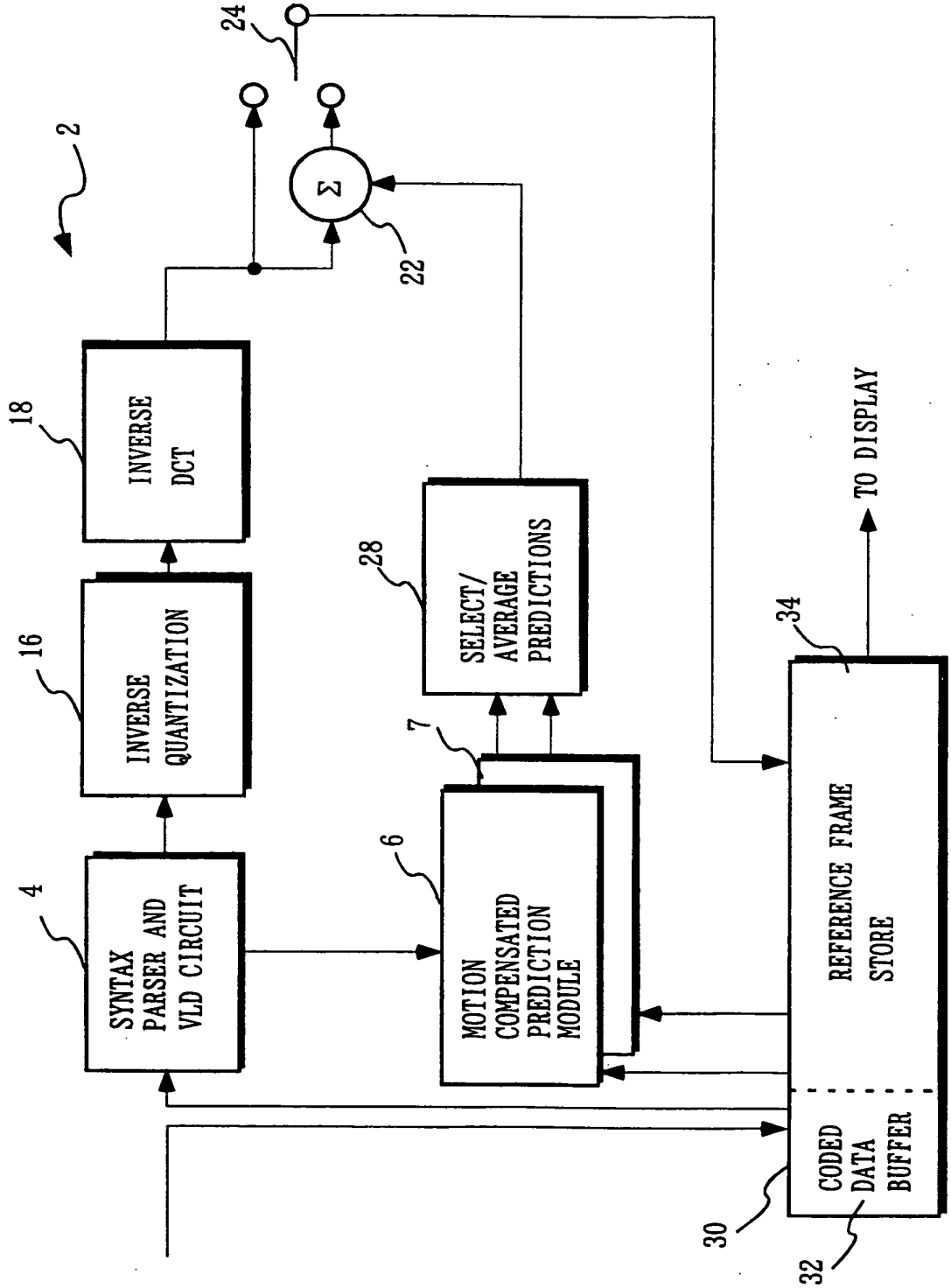


FIG. 2 PRIOR ART

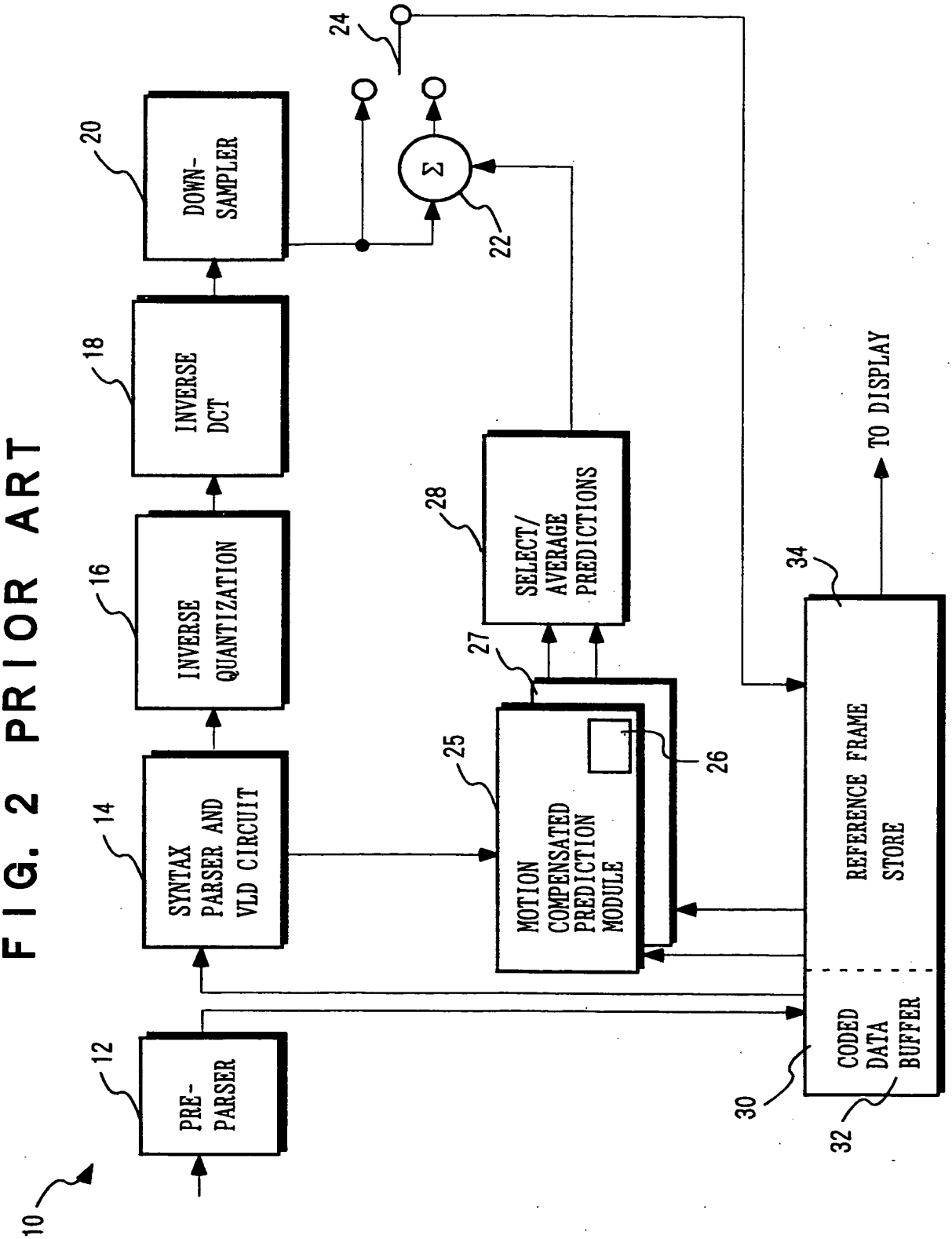
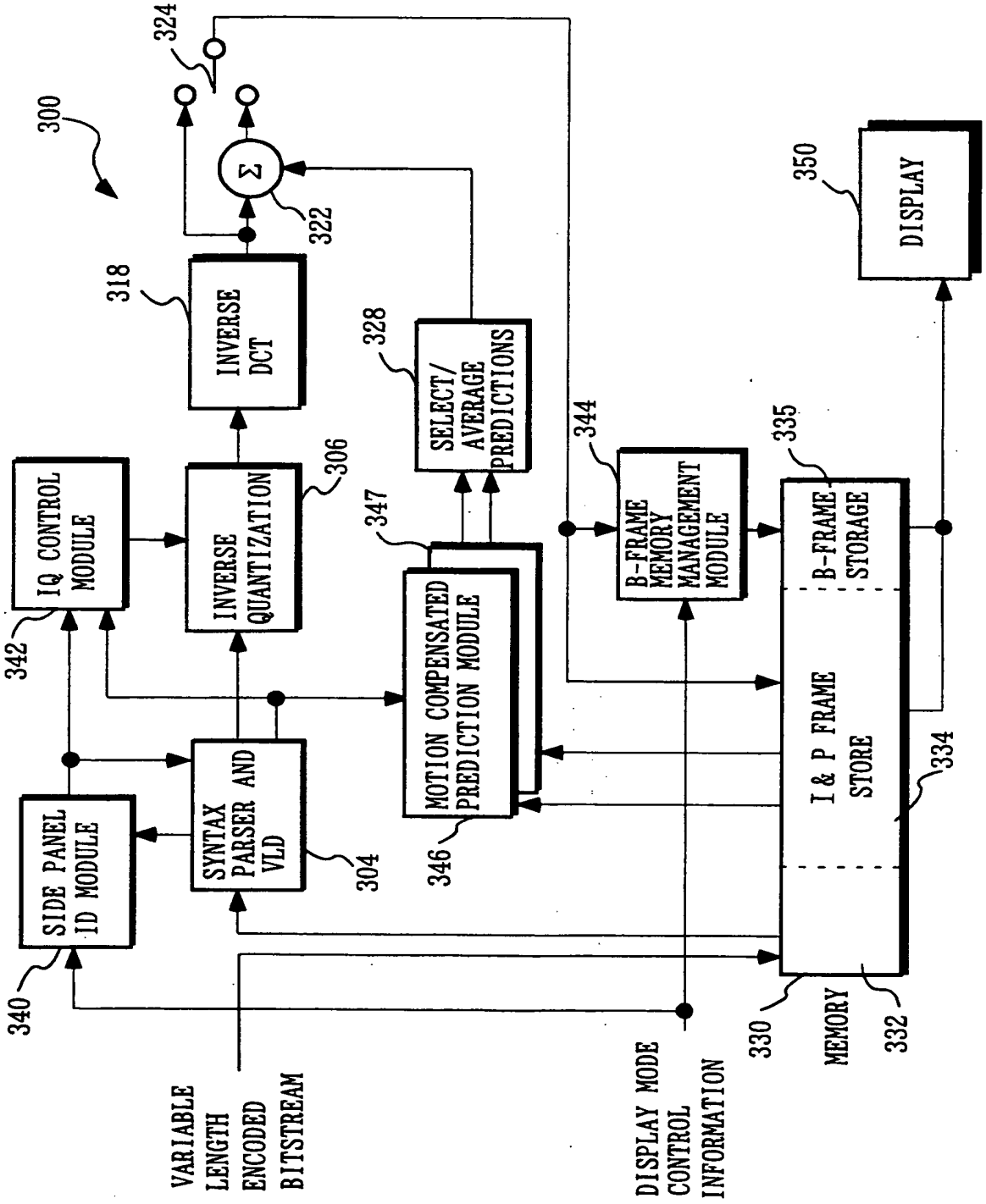


FIG. 3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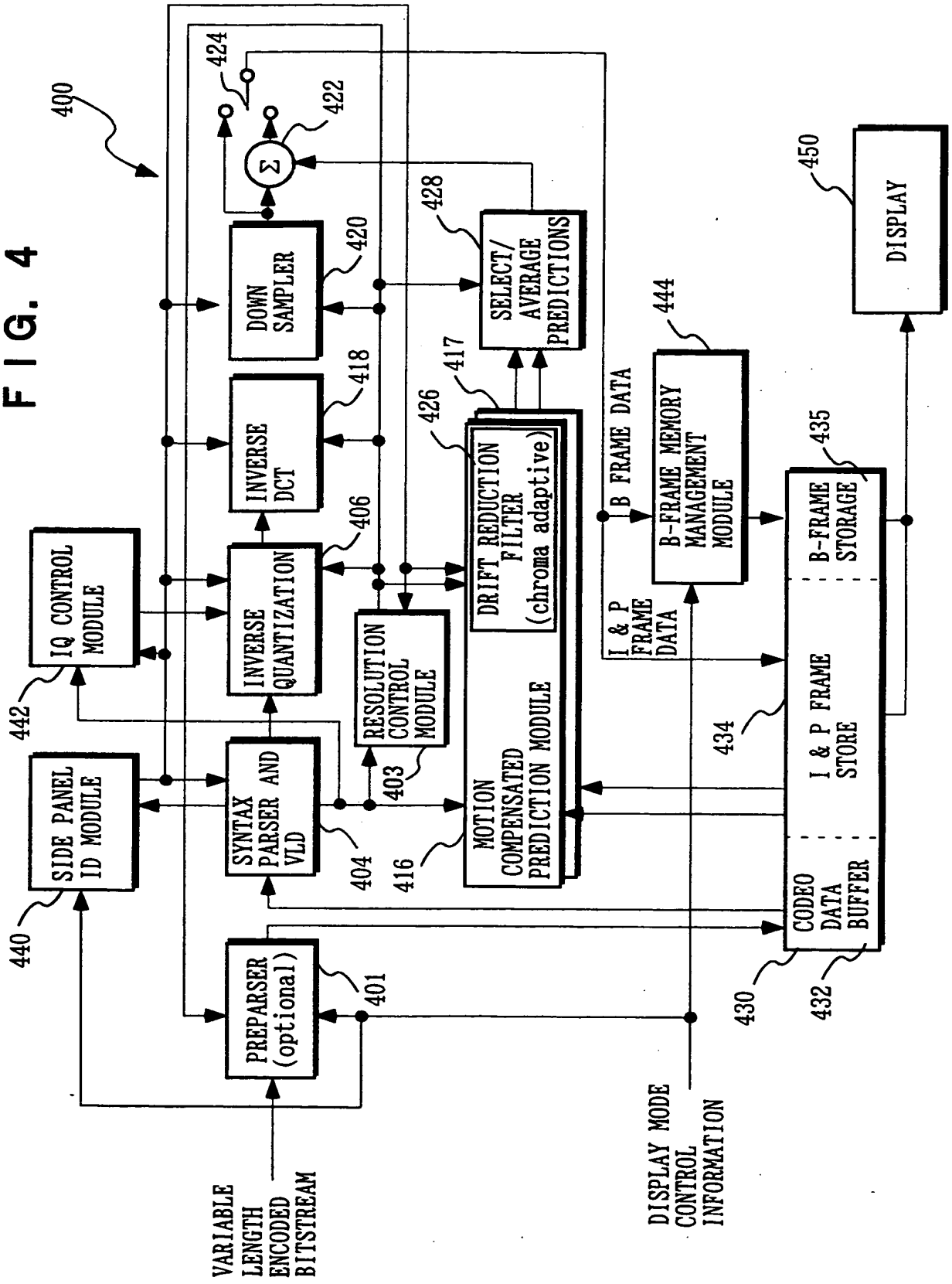
324
322
Σ
318
INVERSE DCT
328
SELECT/ AVERAGE PREDICTIONS
350
DISPLAY
344
335
IQ CONTROL MODULE
INVERSE QUANTIZATION
306
347
B-FRAME MEMORY MANAGEMENT MODULE
B-FRAME STORAGE
342
MOTION COMPENSATED PREDICTION MODULE
I & P FRAME STORE
334
SIDE PANEL ID MODULE
SYNTAX PARSER AND VLD
304
346
340
330
MEMORY
332
VARIABLE LENGTH ENCODED BITSTREAM
DISPLAY MODE CONTROL INFORMATION

FIG. 4


400
424
422
Σ
DOWN SAMPLER
420
428
SELECT/ AVERAGE PREDICTIONS
450
DISPLAY
INVERSE DCT
418
417
426
DRIFT REDUCTION FILTER (chroma adaptive)
B FRAME DATA
444
B-FRAME MEMORY MANAGEMENT MODULE
435
B-FRAME STORAGE
IQ CONTROL MODULE
INVERSE QUANTIZATION
406
RESOLUTION CONTROL MODULE
I & P FRAME DATA
I & P FRAME STORE
442
434
SIDE PANEL ID MODULE
SYNTAX PARSER AND VLD
403
404
416
MOTION COMPENSATED PREDICTION MODULE
440
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432
PREPARSER (optional)
401
VARIABLE LENGTH ENCODED BITSTREAM
DISPLAY MODE CONTROL INFORMATION

FIG. 5 PRIOR ART

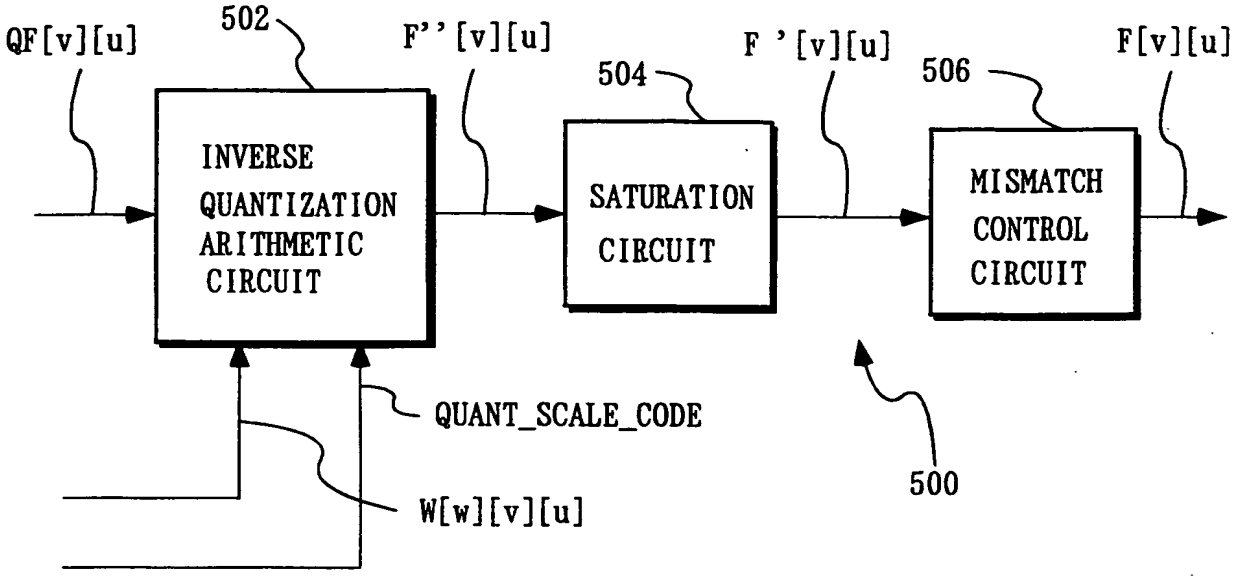
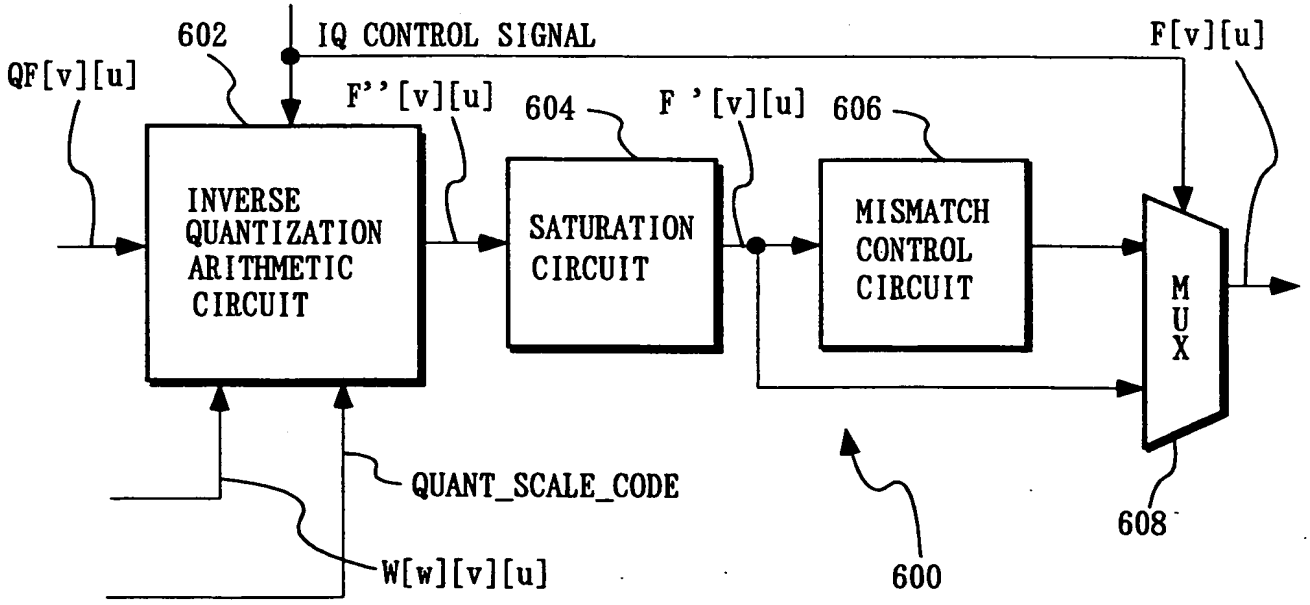


FIG. 6



INTERNATIONAL SEARCH REPORT

Int[illegible]onal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N7/50 H04N7/26

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Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 197 09 391 A (MITSUBISHI SEMICONDUCTOR AMERI) 30 October 1997 (1997-10-30) column 1, line 36 - column 2, line 33 column 5, line 1 - column 5, line 29 column 6, line 5 - column 6, line 14	1-5,12, 13,25-30
A	---	6
A	BOSVELD F ET AL: "A refinement system for hierarchical video coding" , VISUAL COMMUNICATIONS AND IMAGE PROCESSING '90, LAUSANNE, SWITZERLAND, 1-4 OCT. 1990 , PROCEEDINGS OF THE SPIE - THE INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING, 1990, USA, PAGE(S) 575 - 586 XP002110402 ISSN: 0277-786X * sections 2.1, 2.2, 3.2 * ---	1-30
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[X] Further documents are listed in the continuation of box C.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 707 426 A (HITACHI LTD) 17 April 1996 (1996-04-17) column 3, line 44 - column 3, line 59 column 7, line 3 - column 7, line 50 column 12, line 51 - column 13, line 3 column 19, line 25 - column 22, line 34	1-30
A	"TRANSMISSION OF NON-TELEPHONE SIGNALS. INFORMATION TECHNOLOGY - GENERIC CODING OF MOVING PICTURES AND ASSOCIATED AUDIO INFORMATION: VIDEO" , ITU-T TELECOMMUNICATION STANDARIZATION SECTOR OF ITU, PAGE(S) A/B, I - VIII, 1 XP000198491 * sections 6.3.12 - 6.3.14 * * sections 7.4 - 7.4.5 * * sections 7.7 - 7.7.3.2 *	1-30

INTERNATIONAL SEARCH REPORT

.nformation on patent family members

Int[illegible]onal Application No
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